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Indian Standard

BRUSH HOLDERS FOR ELECTRICAL MACHINES — SPECIFICATION

ICS 29.160.10

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Price Group 4

Rotating Machinery Sectional Committee, ET 15

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Rotating Machinery Sectional Committee had been approved by the Electrotechnical Division Council.

This standard has been prepared to cover the following aspects of brush holders:

a) Types of brush holders,

b) Brush pressure,

c) Mounting of brush holders, and

d) Standard dimensions of brush holders compatible with standard brush dimensions specified in IS 13466 : 1992.

IS 12642 : 1989 covers brush holders for sliprings group R, Type RA.

In the preparation of this standard, assistance has been derived from IEC Pub 136 (1986) 'Dimensions of brushes and brush holders for electrical machinery', issued by the International Electrotechnical Commission.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard
BRUSH HOLDERS FOR ELECTRICAL MACHINES — SPECIFICATION

1 SCOPE

This standard applies to brush holders for electrical machinery having cylindrical commutators and sliprings.

2 REFERENCES

The standards given below are referred and form necessary adjunct to this standard :

IS No.	*Title*
4218 (Part 1) : 1976	ISO metric screw threads: Part 1 Basic and design profiles (*first revision*)
13466 : 1992	Specification for brushes for electrical machines [*superseding* IS 3003 (Parts 3 and 4) : 1977]
13584 : 1993	Specification for brush materials for electrical machinery
14195 : 1994/ IEC 1015 (1990)	Brush holders for electrical machines. Guide to the measurement of the static thrust applied to brushes
14196 : 1994/ IEC 560 (1977)	Definitions and terminology of brush holders for electrical machines

3 TERMINOLOGY

For the purpose of this standard the definitions shall be given in IS 14196 : 1994/IEC 560 (1977). The definitions of principal dimensions of brushes and brush holders given in IS 13466 : 1992 shall also apply.

4 TYPES OF BRUSH HOLDERS

Brush holders shall be classified in accordance with the description and illustrations given in Chapter 1 of IS 14196 : 1994/IEC 560 (1977).

5 ARRANGEMENT OF BRUSH HOLDERS

Arrangement of the brush holders shall be in accordance with Chapter II of IS 14196 : 1994/IEC 560 (1977).

6 MOUNTING OF BRUSH HOLDERS

Mounting of brush holders shall be done as per the provisions contained in Chapter III of IS 14196 :1994/ IEC 560 (1977).

6.2 Annex A gives guidance on the points to be checked when mounting a new brush holder.

7 BRUSH PRESSURE

7.1 The correct operating pressure is a major factor in satisfactory carbon brush operation. The operating pressure for the application may be decided by the machine manufacturer.

7.1.1 *Pressure Systems in Brush Holders*

For description and illustrations of pressure systems in brush holders, *see* Chapter IV of IS 14196 : 1994/ IEC 560 (1977).

7.2 Measurement of Static Thrust Applied to Brushes

7.2.1 Static thrust applied to brushes shall be measured in accordance with the method given in IS 14195 : 1994.

7.2.2 *Tolerance on Static Thrust*

Unless otherwise agreed between the manufacturer and the purchaser, static thrust as measured in accordance with **7.2** shall have a tolerance of ± 10 percent.

8 CHARACTERISTICS OF CONSTRUCTION

8.1 In the description of a brush holder, it is necessary to indicate the materials and the nature of its construction. The characteristics of construction of brush holders shall be in accordance with Chapter V of IS 14196 : 1994/IEC 560 (1977).

9 STANDARD DIMENSIONS OF BRUSH HOLDERS

9.1 The brush holders shall be generally chosen in the preferred combinations of principal dimensions t, a and r in accordnace with Table 15 of IS 13466 : 1992.

10 TOLERANCES ON PRINCIPAL DIMENSIONS OF BRUSH HOLDERS

10.1 Tolerances for Brush Holders

10.1.1 Tolerances on dimensions t and a of brush holders are given in Table 1.

10.1.2 The tolerance values for *t* dimension given in Table 1 are mainly for use with radial brushes. It is recognized that for certain type of the brush holders like reaction and trailing, the brush stability does not depend on the clearance between the brush and the brush holder corresponding to dimension *t*. As such tolerances for dimension *t* for the brush holders other than radial shall be agreed to between the user and the supplier.

10.2 Special Allowances for Certain Grades of Brushes

10.2.1 For those grades of brushes which have an abnormally high thermal expansion, for example, certain metal graphite and natural graphite grades, and for metal-coated brushes, the nominal dimensions given in Table 15 of IS 13466 : 1992 may be reduced by an amount at the discretion of brush manufacturer. The tolerances specified in Table 14 of IS 13466 : 1992 shall be applied to the dimensions so reduced. These brushes shall, however, be designated by the nominal dimensions specified in Table 15 of IS 13466 : 1992. The brush manufacturer shall state the reduced nominal dimension when despatching the brushes.

NOTE — In order to check the brush holder dimensions, full form 'go' and 'not go' plug gauges must be used.

11 DIMENSIONS OF THE BRUSH BOX AND PLUG GAUGE CHAMFER

11.1 Measurement of Internal Dimensions of Brush Boxes

11.1.1 The internal dimensions of brush boxes shall be checked with full form plug gauges, sufficiently relieved at the corners to clear the maximum permitted chamfers, by one of the methods given in **11.1.2** and **11.1.3**.

11.1.2 A full form *t* x *a* 'go' gauge should be used to check the minimum dimensions. Individual *t* and *a* 'not go' gauges should be used to check the maximum *t* and *a* dimensions separately. The width of the *t* 'not go' gauge should be the nominal *a* dimension of the box. The width of the *a* 'not go' gauge should be the nominal *t* dimension of the box.

11.1.3 The *t* dimension shall be checked with a 'go and not go' plug gauge, the width of which shall be the minimum *a* dimension. The *a* dimension shall be checked with a 'go and not go' plug gauge, the width of which shall be the minimum *t* dimension.

Table 1 Limits and Tolerances on *t* and *a*

(*Clause* 10.1.1)

Nominal Values mm	Tolerance on *t* and *a* in micrometers	
	Max	*Min*
1.6 2 2.5	+ 54	+ 14
3.2	+ 68	+ 20
4 5	+ 68	+ 20
6.3 8 10	+ 83	+ 25
12.5 16	+ 102	+ 32
20 25	+ 124	+ 40
32 40 50	+ 150	+ 50

11.2 Measurement of Chamfers

11.2.1 Depending upon the method of manufacture, the internal corners of a brush box may not be sharp. In order that a brush which is chamfered in accordance with **10** of IS 13466 : 1992, may not foul the internal corners of the brush box, it is recommended that the boxes be checked for size of the chamfers by plug gauges (*see* Fig. 1).

The dimensions of the chamfer inside the brush box shall be in accordance with Table 2.

12 SERRATIONS ON THE BRUSH HOLDER

For details of serrations on fixing face of the brush holder, serration profile and location, *see* Annex B.

13 BRUSH DESIGN FOR C/F SPRING BRUSHGEAR

Typical brush design for constant force spring brushgear is given in Annex C for information.

14 MARKING

14.1 To avoid confusion between dimensions in millimetres and inches, the brushes and holders shall be marked as:

□ Metric dimensions

△ Inch dimensions

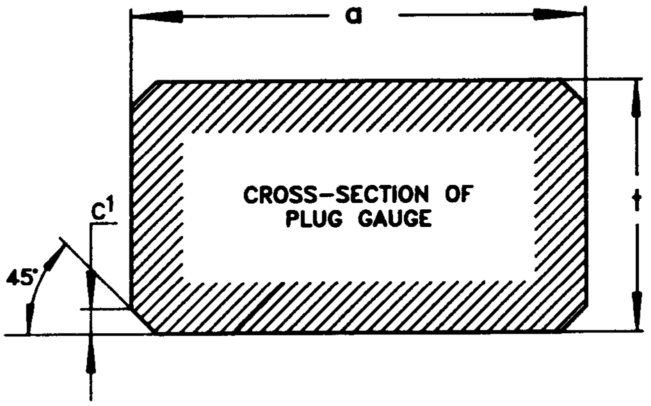


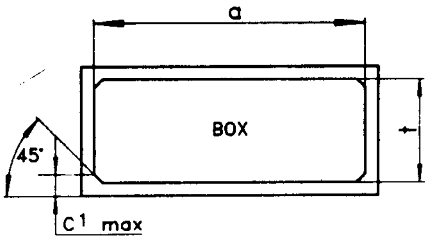
FIG. 1 PLUG GAUGE FOR CHECKING CHAMFER

14.2 For brush holders, taking into account the great variety of shapes and constructions, the marking may be applied where the manufacturer perfers, provided it is visible by the user when the brush holders are mounted on the machine.

Table 2 Dimensions of Chamfers of Brush Box in Millimetres

(*Clause* 11.2.1)

Brush Holder



The Smallest of Dimensions *t* or *a*	Maximum Value of C^1 of the Brush Box
1.6	0.125
2	0.125
2.5	0.16
3.2	0.16
4	0.20
5	0.25
6.3	0.32
8	0.40
10	0.63
12.5	
16	
20	
25	1.25
32	
40	
50	

ANNEX A

(*Clause* 6.2)

GUIDANCE ON MOUNTING OF BRUSH HOLDER

A-1 RADIAL CLEARANCE BETWEEN BRUSH HOLDER AND COMMUTATOR OR SLIPRING

Radial clearance between bottom edge of the brush holder and commutator or slipring depends on the design of the electrical machine. However, it is normally between 1.6 to 3.2 mm, with 2.4 mm as a nominal value.

The brush holder is set to obtain the radial clearance within the special limits, but as close as possible to the nominal value, by means of the adjustment provided in the holder/clamp assembly or by adjusting the brush arc (*see* Fig. 2).

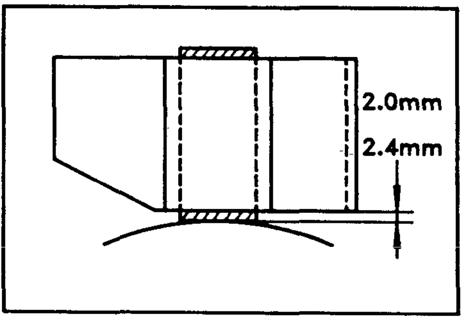


FIG. 2 BRUSH BOX CLEARANCE

A-2 ANGLES FOR BEVELS

The angles for contact bevel and top bevel on the brush holders shall suit the respective angles of the brushes as per **11** of IS 13466 : 1992.

A-3 ANGLE AT WHICH BRUSH HOLDER MEETS THE COMMUTATOR

Care shall be taken to set the brush holders at the angle for which they are designed. To check this, place a new unbedded brush in the holder, having first rubbed the contact surface with chalk. Press the brush against the commutator and, if possible, rotate the armature slightly. On removal from the holder the chalked surface should show a mark where it has touched the commutator. If this mark is on the centre line or between the centre line and a third toward the entering edge, the setting is satisfactory. If the mark is on the leaving half of the brush surface, the brush holder should be reset. This is particularly important in the case of radial holders, because it indicates a small reaction angle, which is a very frequent cause of brush instability (*see* Fig. 3).

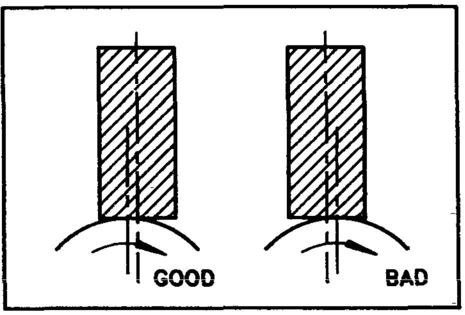


FIG. 3 BRUSH ANGLE

A-4 ALIGNMENT OF HOLDERS ON EACH ARM

Brush holders shall be correctly lined up with the commutator segments. This shall be checked by turning the armature until the edge of one segment is just touching the leaving edge of the brushes (*see* **A-6**).

A-5 SPACING OF HOLDERS ROUND THE COMMUTATOR

Some machines are very sensitive to irregularities of brush spacings. This shall be checked by wrapping paper tape round the commutator under one track of brush holders and marking the position of the leaving edge of each holder by means of a sharpened pencil held tightly against the leaving face of the brush box. The paper shall be removed and the spacing between the marks measured. Unless the brush arrangement has been designed with circumferential stagger, the spacing shall be within 1 mm.

A-6 BRUSH HOLDER STAGGER

A-6.1 On some electrical machines the brush holders on successive pair of arms are staggered axially to minimize formation of ridges on commutator or slip-ring surface, when there are two or more brushes per arm and more than two poles.

While providing axial stagger, it is necessary to ensure that the brush track on the commutator or slip-ring surface carries equal number of positive and negative brushes.

A-6.2 On some machines some of the brushes on each spindle are deliberately set in advance of the remaining brushes on the same spindle. This is called circumferential stagger and is a design requirement (*see* Fig. 4).

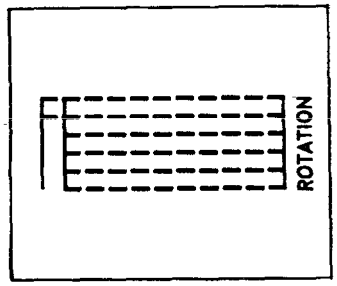


FIG. 4 DIAGRAM ILLUSTRATING CORRECT AXIAL STAGGERING

A-6.3 Axial and circumference staggers are design requirements and shall not be altered when the machine is received or subsequently, without prior consent of the machine manufacturer.

A-7 POSITION OF BRUSH ROCKER

A-7.1 If the new brush holders are not exactly the same pattern as the old, check that the circumferential distance from the centre of the brush contact surface to the fixing point on the brush arm has been unaltered. If it is different, the brush rocker shall be moved to compensate for this and the neutral position then rechecked and marked.

NOTE — If the machine is fitted with holders facing opposite ways in order to facilitate access, no change in the circumferential fixing distance is permissible.

ANNEX B

(*Clause* 12)

SERRATIONS ON THE BRUSH HOLDER

B-1 SERRATIONS ON FIXING FACE OF THE BRUSH HOLDERS

B-1.1 Where the radial adjustment of a brush holder is controlled by the mating of serrations on the fixing face of the brush holder with corresponding serrations on the brush holder support, the tooth form and dimensions of the serrations should be in accordance with thread profile of 1 mm pitch of IS 4218 (Part 1) : 1976.

B-1.2 Profile of Serrations

The recommended profile of serration is shown in Fig. 5.

B-2 LOCATION OF SERRATIONS

B-2.1 In order that a number of brush holders, fixed to a single brush holder support, may be capable of being adjusted to lie at the same distance from the commutator of slip-ring surface, the position of the serrations in relation to the bottom of the box should be in accordance with Fig. 6.

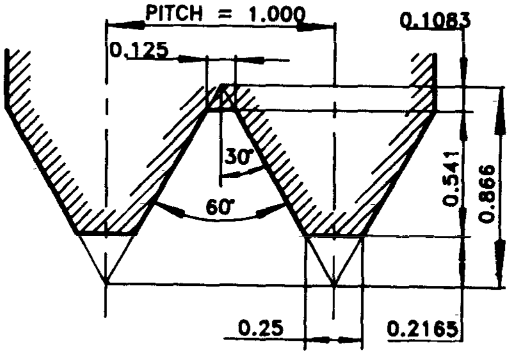


FIG. 5 PROFILE OF SERRATIONS ON FACE OF BRUSH HOLDER

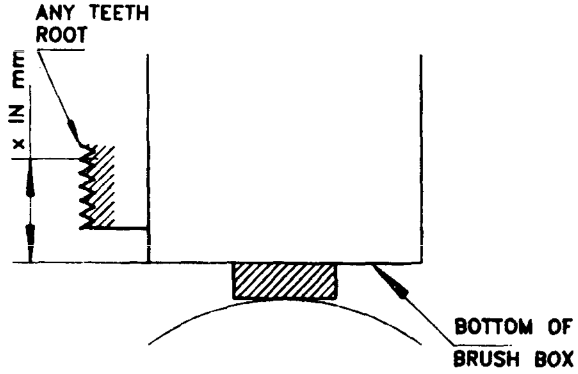


FIG. 6 LOCATION OF SERRATIONS

ANNEX C

(*Clause* 13)

TYPICAL BRUSH DESIGN FOR CONSTANT FORCE (CF) SPRING BRUSHGEAR

C-1 TYPICAL ARRANGEMENTS

C-1.0 In the majority of applications machine rotation is undirectional, nevertheless, the actual direction is often not specified at the design stage. As a result when using conventional brushgear, it has become necessary to fit radial brushes with flat tops. This can be disadvantageous in some brushgear designs and can lead to indefinite location of the brush in the brush box.

C-1.1 The symmetrical latching arrangement embodied in c/f spring radial brushgear, permits the use of radial brushes having a top bevel so that with the brush holder permanently located, the spring assembly and brush need only be turned through 180°C to accommodate a change in the direction of rotation (Fig. 7A and 7B). The combination of top bevel and the direction of frictional force ensures correct brush-face location. A top bevel of 22.5° is fully compatible with c/f spring brushgear designs.

C-1.2 Trailing or reaction brushes can be used on unidirectional machines where the direction of rotation is firmly established (Fig. 7C and 7D).

C-1.3 Flat-topped brushes with an axial groove to locate the spring are rocommended for medium-size reversing machines (Fig. 7E) and special designs incorporating a bevel top for large high-speed machines.

C-2 INSULATION

It is recommended to insulate the spring from the brush by *fitting a non-conducting* insert to the top of the brush where the spring bears upon it.

C-3 PRINCIPAL DIMENSIONS

Table 3 gives the preferable combinations of the principal dimensions *t*, *a* and *r* for brushes suitable for use with constant force brush holders.

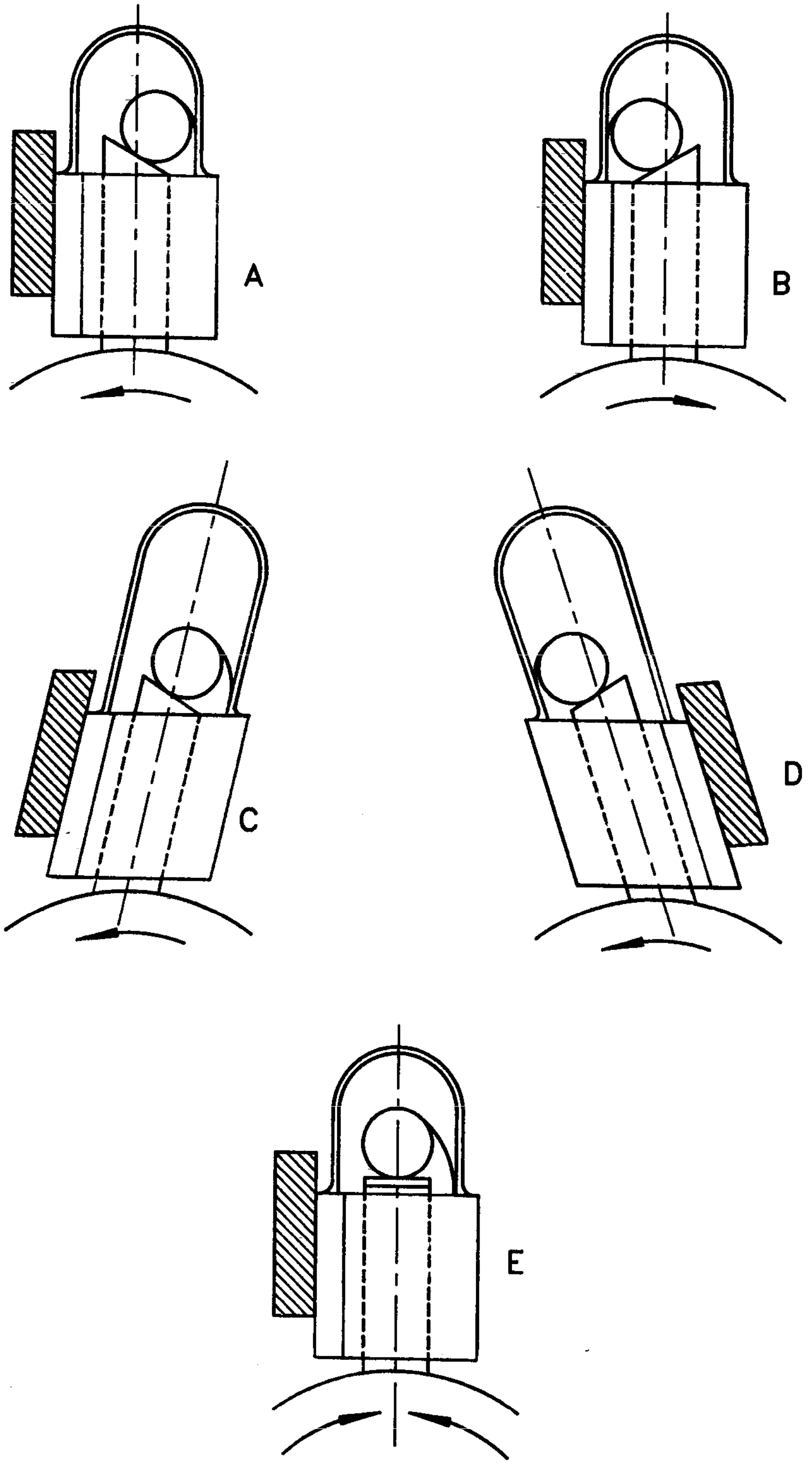


FIG. 7 TYPICAL BRUSH DESIGN FOR CONSTANT FORCE SPRING BRUSHGEAR

Table 3 Combinations of the Principal Dimensions *t*, *a* and *r* for Brushes Suitable for Use with Constant Force Brush Holders

(*Clause* C-3)

a *t*	16	20	25	32	40
6.3		40 50	50	50 64 80	50 64 80
8	40	40 50			
10	40	50 64	64	64	
12.5	40	50 64	64	64	
16		64	64	64 80	
20			64	64 80	
25				80	
32	64 80 100 125	64 80 100 125	64 80 100 125		80 100 125
40	64 80 100 125	64 80 100 125	64 80 100 125	80 100 125	
50	80 100 125	80 100 125	80 100 125		

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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 323 01 31, 323 94 02, 323 83 75

Telegrams: Manaksanstha (Common to all offices)

Regional Offices: Telephone

Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg
NEW DELHI 110002
{ 323 76 17, 323 38 41

Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola
CALCUTTA 700054
{ 337 84 99, 337 85 61, 337 86 26, 337 86 62

Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022
{ 60 38 43, 60 20 25

Southern : C. I. T. Campus, IV Cross Road, MADRAS 600113
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